



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/096,858	06/12/1998	PRAVIN K. NARWANKAR	AMAT2571.US/	2295
32588	7590	04/06/2004	EXAMINER	
APPLIED MATERIALS, INC. 2881 SCOTT BLVD. M/S 2061 SANTA CLARA, CA 95050			MAI, ANH D	
			ART UNIT	PAPER NUMBER
			2814	

DATE MAILED: 04/06/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/096,858

Applicant(s)

NARWANKAR ET AL.

Examiner

Anh D. Mai

Art Unit

2814

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 11 March 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-7 and 14-45 is/are pending in the application.
- 4a) Of the above claim(s) 32-45 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-7, 14-29 and 31 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- ☒ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.
- ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____.
- ☐ Notice of Informal Patent Application (PTO-152)
- ☐ Other: _____.

DETAILED ACTION

Status of the Claims

1. Supplemental Amendment filed March 11, 2004 has been entered. Claims 1, 14, 15 and 24 have been amended. Claims 1-7, 14-29 and 31 are pending.

Claim Rejections - 35 USC § 103

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

2. Claims 1, 2, 4-7, 14-17, 19 and 21-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Carl et al. (U.S. Patent No. 5,468,687) (of record) in view of Suzuki (U.S. Patent No. 5,707,692) and Slomowitz (U.S. Patent No. 4,888,088) (of record).

With respect to claim 1, Carl teaches a method of forming a dielectric layer of a device substantially as claimed including:

depositing a dielectric layer (Ta_2O_5) on a substrate in a chamber;

exposing the as deposited dielectric layer (Ta_2O_5) to reactive oxygen atoms in the chamber to form a reactive oxygen atom exposed as deposited dielectric layer (Ta_2O_5) and to improve the electrical performance of the as deposited dielectric layer (Ta_2O_5); and

forming an electrode (aluminum) above the reactive oxygen atom exposed as deposited dielectric layer. (See col. 1-3).

Art Unit: 2814

Thus, Carl is shown to teach all the features of the claim with the exception of exposing the as deposited dielectric layer to reactive oxygen atom generating remotely from the depositing chamber.

However, Suzuki teaches that exposing a base substance to neutral excited species (hence electrically neutral reactive atom) would reduce damage to the base substance as compared to the conventional plasma processing, where the plasma producing chamber and the processing chamber are separated away from each other. (See col. 1).

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to expose the as deposited dielectric layer of Carl to the neutral excited species generates remotely as taught by Suzuki to avoid damage to the as deposit dielectric layer but still improves the electrical performance of the dielectric layer.

With respect to internal steps of creating the electrically neutral reactive oxygen atoms of the remote plasma chamber, the electrically neutral reactive oxygen atoms generate by the remote plasma is well known to the ordinary skill in the art and detailed in Slomowitz '088.

With respect to claim 2, the dielectric of Carl is a metal oxide dielectric formed at a first temperature (460 °C), and wherein the dielectric layer is exposed to the electrically neutral reactive oxygen atoms at a second temperature (400 °C) which is less than the first temperature.

With respect to claim 4, the dielectric layer of Carl comprises a metal-oxide.

With respect to claim 5, the dielectric layer of Carl comprises transition metal dielectric.

Art Unit: 2814

With respect to claim 6, the dielectric layer of Carl comprises Ta_2O_5 .

With respect to claim 7, in view of Suzuki, the dielectric layer of Carl is exposed to the active atomic species while being heated to a temperature of 400 °C, which is encompassed the claimed term.

With respect to claim 14, Carl teaches a method of annealing a deposited oxide of a device substantially similar as claimed including:

locating a substrate in a chamber, the substrate having an as deposited oxide (Ta_2O_5) formed thereon;

exposing the as deposited oxide (Ta_2O_5) to the reactive oxygen atoms to form an reactive oxygen atom exposed as deposited dielectric layer (Ta_2O_5) and to improve the electrical performance of the as deposited dielectric layer; and

forming an electrode (aluminum) above the active atomic species exposed as deposited oxide layer. (See col. 1-3).

Regarding the generating a plasma in a second (remote) chamber and exposing the as deposited dielectric layer to electrically neutral reactive oxygen atom, a similar reasoning as that of claim 1 is also applied here.

With respect to claim 15, in view of Suzuki, the as dielectric oxide of Carl is exposed to the reactive oxygen atom while being heated to a temperature of 400 °C, which is encompassed the claimed term.

Art Unit: 2814

With respect to claim 16, in view of Slomowitz, the remote plasma (second chamber) is a microwave applicator cavity of a remote plasma generator. (See Fig. 1).

With respect to claim 17, the reactive oxygen atoms of Carl are formed by generating a plasma from O₂ molecules.

With respect to claim 19, in view of Slomowitz, microwave is utilized to form reactive species.

With respect to claim 21, the deposited oxide of Carl comprises a metal-oxide.

With respect to claim 22, the deposited metal oxide of Carl comprises transition metal dielectric.

With respect to claim 23, the dielectric layer of Carl comprises Ta₂O₅.

3. Claims 24, 25, 27, 28 and 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Carl '687 in view of Suzuki '692; Slomowitz '088 and Park et al. (U.S. Patent No. 5,780,115).

With respect to claim 24, Carl teaches a method of forming a capacitor substantially as claimed including:

depositing a transition metal dielectric (capacitor dielectric, Ta₂O₅) in a deposition chamber;

annealing the as deposited transition metal dielectric (Ta₂O₅) in the deposition chamber by exposing the as deposited transition metal dielectric (Ta₂O₅) to the reactive oxygen atoms to form a reactive oxygen atom exposed as deposited dielectric layer (Ta₂O₅) and to improve the electrical performance of the as deposited dielectric layer; and

Art Unit: 2814

forming a top electrode (aluminum) above the reactive oxygen atom exposed transition metal dielectric. (See Col. 1-3).

Thus, Carl is shown to teach all the features of the claim with the exception of explicitly disclosing that the transition metal dielectric (capacitor dielectric, Ta_2O_5) is formed on a bottom electrode and exposing the as deposited transition metal dielectric to reactive oxygen atoms generating remotely from the depositing chamber.

However, Park teaches forming a capacitor including forming a capacitor dielectric (17) on a bottom electrode (15).

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to form the transition metal capacitor dielectric of Carl on the bottom electrode as taught by Park to form a capacitor.

With respect to generating a plasma in a second (remote) chamber and exposing the as deposited dielectric layer to electrically neutral reactive oxygen atom, a similar reasoning as that of claim 1 is also applied here.

With respect to claim 25, the transition metal dielectric of Carl is tantalum pentaoxide (Ta_2O_5) deposited by chemical vapor deposition utilizing a source gas comprising TAETO.

With respect to claim 27, the tantalum pentaoxide dielectric layer of Carl is formed utilizing a source gas comprising O_2 .

Art Unit: 2814

With respect to claim 28, the transition metal dielectric layer of Carl is deposited at a temperature between 300-500 °C (460°C).

With respect to claim 31, the transition metal dielectric layer of Carl is annealed at a temperature of 400 °C, thus, encompasses the claimed range.

4. Claims 3, 18 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Carl '687, Suzuki '692 and Slomowitz '088 as applied to claim 1 above, and further in view Park '115.

With respect to claims 3 and 20, Carl, Suzuki and Slomowitz teach depositing a dielectric layer on a substrate.

Thus, Carl, Suzuki and Slomowitz are shown to teach all the features of the claim with the exception of forming the dielectric layer comprises titanium oxide.

However, Park teaches dielectric layer comprises titanium oxide (claim 3) or tantalum pentaoxide or silicon oxide (claim 20) are well known. (See col. 4, ll. 8-21).

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to form the dielectric layer of Carl comprises titanium oxide or silicon oxide as taught by Park '115 because they can be used interchangeably as capacitor dielectric.

With respect to claim 18, Carl teaches in view of Park, N₂O or O₂ are well known in the art to generate oxygen for plasma treatment.

Art Unit: 2814

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to expose the as deposited oxide of Carl using use N_2O as taught by Park to generate reactive oxygen atoms.

5. Claims 26 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Carl '687, Suzuki '692, Slomowitz '088 and Park '115 as applied to claim 24 above, and further in view of Hasegawa (U.S. Patent No. 5,677,015) of record.

Carl, Suzuki, Slomowitz and Park teach all of the features of the claim with the exception of forming the transition metal dielectric (Ta_2O_5) utilizing TAT-DMAE (claim 26) and N_2O (claim 29) as the source gas.

However, Hasegawa teaches forming the transition metal dielectric (22) utilizing source gases comprising TAT-DMAE and N_2O .

Therefore, it would have been obvious to one having ordinary skill in the art at the time of the invention was made to form the transition metal dielectric (Ta_2O_5) of Carl utilizing the source gases as taught by Hasegawa since forming Ta_2O_5 utilizing these gases are well known.

Response to Arguments

6. Applicant's arguments with respect to all claims have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

7. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Anh D. Mai whose telephone number is (571) 272-1710. The examiner can normally be reached on 9:00AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (571) 272-1705. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR

Art Unit: 2814

system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A.M
March 30, 2004

Wael Fahmy
SPE 2814